AMENDMENT UNDER 37 C.F.R. § 1.116
EXPEDITED PROCEDURE
GROUP 2125
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Kazuhiko HIGASHI

Docket No: Q68150

Appln. No.: 10/031,705

Group Art Unit: 2125

Confirmation No.: 6333

Examiner: Ryan A. JARRETT

Filed: January 22, 2002

For: NUMERICAL CONTROL SYSTEM AND METHOD FOR SETTING COMMUNICATION TIMING IN NUMERICAL CONTROL SYSTEM

AMENDMENT UNDER 37 C.F.R. § 1.116

MAIL STOP AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office Action dated October 25, 2006, please amend the above-identified application as follows on the accompanying pages.

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. - 12. (canceled).

13. (currently amended): A numerical control system comprising:

a numerical control apparatus;

a communication cable including a data transmission cable for data transmission and a data transmission cable for data reception; and

a plurality of peripheral devices including at least one of a servo amplifier, a spindle amplifier and a remote I/O unit, the peripheral devices serially connected with the numerical control apparatus through the communication cable in order to perform time-division-based communications between the numerical control apparatus and the peripheral devices,

wherein a communication cycle in the communications between the numerical control apparatus and the peripheral devices is split into a plurality of sub cycles, and the data to be processed in the communication cycle are split into the plurality of sub cycles and split for each of the plurality of peripheral devices to be communicated with the numerical control apparatus to process the split data ~~to be processed in the communication cycle~~ in the split plurality of sub cycles, and

wherein the data to be processed is stored in a receiving device, said receiving device being the numerical control apparatus or at least one of the plurality of peripheral devices.

14. (withdrawn): The numerical control system according to claim 13, wherein an emergency stop information section is provided in a communication frame used in the communications between the numerical control apparatus and the peripheral devices, and an emergency stop information section is provided in each piece of data split into the plurality of sub cycles.

15. (withdrawn): The numerical control system according to claim 14, wherein each of the numerical control apparatus and the peripheral devices comprises a receiving controller for checking the emergency stop information section in the received communication frame irrespective of the station address specified in the transmitted communication frame in case a receiving error occurs.

16. (withdrawn): The numerical control system according to claim 14, wherein the communication frame comprises a gating off system information section for specifying a system to be gated off in the communication frame,

the numerical control apparatus specifies the system to be gated off in the gating off system information section and transmits the communication frame to the peripheral devices,

the peripheral devices performs gates off the peripheral devices per each system specified by the communication frame.

17. (previously presented): A method for setting a communication timing in a numerical control system, the numerical control system comprising:

a numerical control apparatus;

a communication cable including a data transmission cable for data transmission and a data transmission cable for data reception; and peripheral devices including at least one of a servo amplifier, a spindle amplifier and a remote I/O unit, the peripheral devices serially connected with the numerical control apparatus through the communication cable in order to perform time-division-based communications between the numerical control apparatus and the peripheral devices,

the method comprising the steps of:

transmitting a port connection confirmation command to the peripheral devices in initial communications,

recognizing the connection state of the peripheral devices;

calculating the number of the peripheral devices connected and the transmission timing of the peripheral devices from the number of model codes and the order of model codes appended to a port information command when a response to the port connection confirmation command and the port information command are received from the peripheral devices; and

transmitting the calculated number of connections and transmission timing to the peripheral devices as a node count notice command and a communication timing setup command, and

transmitting the response to the port connection confirmation command to upstream nodes after the port connection confirmation command is received;

transmitting the port connection confirmation command to downstream nodes after the port connection confirmation command is received,

appending a model code allocated to the port information command in advance to transmitting the resulting port information command to upstream nodes;

retaining the number of connections and transmission timing specified in the node count notice command and communication timing setup command when the node count notice command and communication timing setup command are received,

wherein the communication timing of the peripheral devices is automatically set via initial communications between the numerical control apparatus and the peripheral devices.

18. (currently amended): The numerical control system according to claim 13, wherein the peripheral devices, when a synchronization frame transmitted downstream from the numerical control apparatus is received in initial communications, output a synchronization signal and calculate the time required for a respective peripheral device as the most downstream node to receive the synchronization frame.

19. (previously presented): The numerical control system according to claim 18, wherein the peripheral devices calculate a transmission timing that considers a transmission delay between peripheral devices based on connection information transmitted from the numerical control apparatus in initial communications.

20. (previously presented): The numerical control system according to claim 18, wherein the numerical control apparatus and the peripheral devices each has a transmission controller for a port 1, a receiving controller for the port 1, a transmission controller for a port 2, and a receiving controller for the port 2,

wherein the numerical control apparatus recognizes the connection state of the peripheral devices, counts the number of the peripheral devices nodes and calculates a first transmission timing of each of the peripheral devices, calculates a second transmission timing in communications between the peripheral devices from data volume of communication frames transmitted to the peripheral devices and data volume of communication frames transmitted by the peripheral devices in communications between peripheral devices, and transmits the first and second transmission timings and the node count to the peripheral devices,

wherein the peripheral devices retain the node count and the first transmission timing transmitted from the numerical control apparatus in initial communications as well as the second transmission timing in order to perform communications between peripheral devices by using the second transmission timing in the communications between peripheral devices.

21. (withdrawn): The numerical control system according to claim 13, wherein the numerical control apparatus and the peripheral devices each has a transmission controller for a port 1, a receiving controller for the port 1, a transmission controller for a port 2, and a receiving controller for the port 2,

wherein the numerical control apparatus, on occurrence of an alarm, transmits alarm information to devices connected upstream of the transmission controller for the port 1 as well as nodes downstream of the transmission controller for the port 2.

22. (withdrawn): The numerical control system according to claim 21, wherein information such as an alarm, gating off, and emergency stop included in a communication frame received by a port 1 receiving controller or port 2 receiving controller is latched and the information is appended to a communication frame to be transmitted from a port 2 transmission controller or port 1 transmission controller.

23. (withdrawn): The numerical control system according to claim 13, wherein, when the write pointer is out of synchronization with the read pointer in the communication control buffer or when the communication control buffer is reset, a first bit pattern output after the read pointer has moved is not a specific bit pattern serving as a flag.

24. (withdrawn): The numerical control system according to claim 13, wherein dummy data is created for balancing the bit pattern of a start flag and the bit count in data transmission using optical transmission modules so as to transmit the dummy data in combination with the start flag.

25. (withdrawn): The numerical control system according to claim 13, wherein, in each cycle, the data transmission cable for data transmission transmits data in a single direction in the

plurality of sub cycles and the data transmission cable for data reception transmits data in another single direction in the plurality of sub cycles.

26. (withdrawn): The numerical control system according to claim 25, wherein, in the plurality of sub cycles of the cycle, data is transmitted in a single direction only in each of the transmission cables at substantially same time.

27. (withdrawn): The numerical control system according to claim 13, wherein in each sub cycle of the cycle, data is transmitted a plurality of times in different frames.

28. (withdrawn): The numerical control system according to claim 13, wherein, in the plurality of sub cycles, at least one of the data transmission cable for data transmission and the data transmission cable for data reception, transmits data in a single direction in the plurality of sub cycles.

29. (withdrawn): The numerical control system according to claim 13, wherein the data transmission cable for data transmission is a dedicated channel for the transmission of data and the data transmission cable for data reception is a dedicated channel for the reception of data.

30. (withdrawn): The numerical control system according to claim 29, wherein, in each of the plurality of sub cycles, each of the data transmission cable for data transmission and the data transmission cable for data reception is configured to carry data.

AMENDMENTS TO THE DRAWINGS

Figures 20 and 24 are labeled "related art" and Figure 24 is amended to cure a typographical error.

Attachment: Two (2) Replacement Drawings

REMARKS

Claims 13-30 are all the claims pending in the application. Claims 14-16 and 21-30 are withdrawn from consideration as being drawn to a non-elected invention. Claims 13 and 17-20 have been examined. By this Amendment, Applicant amends claim 13 to further clarify the invention.

I. Summary of the Office Action

The Examiner has maintained some of the drawing objections and the rejection of claims 13 and 18-20. Claim 17 is allowed.

II. Restriction Requirement

The Examiner has restricted the previously added claims 25-30. Applicant respectfully traverses this restriction requirement.

Claims 25-30 share the same technical features at least by virtue of their dependency and at least because an example of the invention set forth in claims 13 and 25-30 is illustrated by the first exemplary embodiment in the specification, *e.g.* pages 23 to 28 of the specification. Claims 25-30 further clarify the invention set forth in claim 13. Applicant respectfully requests the Examiner to withdraw this restriction or show how the invention set forth in claims 25-30 is independent and distinct.

III. Objections to the Drawings

The Examiner maintained the objection of Figures 20 and 24. Applicant respectfully resubmits Figures 20 and 24 with "related art" labels and correcting a misspelling in Figure 24. Applicant respectfully requests that the Examiner withdraw these objections in view of the self-explanatory amendments to the figures.

IV. Claim Rejections under 35 U.S.C. § 101

Claims 13 and 18-20 are rejected under 35 U.S.C. § 101 because the claimed invention is allegedly directed to non-statutory subject matter. Applicant respectfully requests the Examiner to withdraw this rejection of claim 13 and its dependent claims 18-20 in view of the self-explanatory amendments to claim 13 being made herein.

V. Claim Rejections under 35 U.S.C. § 112

Claims 18-20 are rejected under 35 U.S.C. § 112, second paragraph. Applicant respectfully traverses this rejection in view of the following comments.

Claim 18 is rejected as allegedly being unclear because there can only be one most downstream node (*see* pages 7-8 of the Office Action). While there can only be one most downstream node, various nodes can ***pretend as if*** they are the most downstream node. That is, each peripheral device outputs the synchronization signal and calculates the time as if it was the most downstream node.

By way of analogy, twenty people are standing in line. The tenth person in line is approached and is asked to pretend that he is the last person line and to calculate the number of persons in line. The tenth person indicates, as if he is the last person in line, that there are ten persons in line. Since claim 18 does not recite that each peripheral device ***is*** the most downstream node but recites that it calculates time ***as*** the most downstream node, claim 18 is clear and definite.

Accordingly, Applicant respectfully requests the Examiner to withdraw this rejection of claim 18.

VI. Claim Rejections under 35 U.S.C. § 102

Claim 13 is rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,822,615 to Yamashita et al.[1] (hereinafter "Yamashita"). Applicant respectfully traverses these grounds of rejection in view of the following comments.

Independent claim 13, among a number of unique features, recites: "wherein a communication cycle in the communications between the numerical control apparatus and the peripheral devices is split into a plurality of sub cycles, and the data to be processed in the communication cycle are split into the plurality of sub cycles and split for each of the plurality of peripheral devices to be communicated with the numerical control apparatus to process the split data in the split plurality of sub cycles."

That is, in an exemplary, non-limiting embodiment, the data is split into each of the sub cycles and is also split for each of the peripheral devices. In other words, the numerical control apparatus can process the communication with each of the peripheral devices in each of the subcycles, thereby assuring the real-time conveyance of information. Accordingly, necessary information can be transmitted in one communication cycle and the real-time conveyance of the information is assured. It will be appreciated that the foregoing remarks relate to the invention in a general sense, the remarks are not necessarily limitative of any claims and are intended only to help the Examiner better understand the distinguishing aspects of the claim mentioned above.

Yamashita discloses communication between an NC unit and a remote I/O unit and a timing chart in one cycle interval (allegedly one communication cycle). Yamashita further discloses that each one cycle interval is split into a plurality of transmission/receiving cycles

[1] Cited by Applicant in the Information Disclosure Statement filed on January 22, 2002.

(allegedly sub cycles) and the data is transmitted/received into the split cycles (Fig. 9; col. 19, line 37 to col. 20, line 20).

In Yamashita, however, the destination unit communicates with the NC unit in each of the transmission/receiving cycles. In other words, the one cycle interval (allegedly one communication cycle) is limited to one remote I/O unit. That is, Yamashita fails to disclose or suggest the NC unit communicating with a number of remote I/O units in each of the plurality of transmission/receiving cycles (allegedly sub cycles). Yamashita only discloses communicating with one remote I/O unit in each transmission/receiving cycles. Yamashita requires one cycle interval to process the data for each of the remote I/O units. Thus, in Yamashita, it is impossible to convey real-time information. In short, Yamashita does not disclose or suggest in each of the transmission/receiving cycle (allegedly the sub cycle) communicating with a plurality of remote I/O units. In Yamashita, the data is not split for each of the peripheral devices.

In summary, Yamashita is directed to reducing size and improving costs, safety and reliability of the communication. Accordingly, bidirectional, serial communication between the NC unit and the remote I/O unit is executed by means of time division (col. 5, lines 2 to 6). In other words, Yamashita is unrelated to real time conveyance of information between the NC unit and a number of remote I/O units.

Therefore, "a communication cycle in the communications between the numerical control apparatus and the peripheral devices is split into a plurality of sub cycles, and the data to be processed in the communication cycle are split into the plurality of sub cycles and split for each of the plurality of peripheral devices to be communicated with the numerical control apparatus to process the split data in the split plurality of sub cycles," as set forth in claim 13 is not disclosed

by Yamashita, which lacks in each sub cycle, the NC unit communicating with a number of remote I/O units. For at least these exemplary reasons, claim 13 is patentably distinguishable from Yamashita. In view of the foregoing, Applicant respectfully requests the Examiner to withdraw this rejection of claim 13.

VII. Allowable Subject Matter

Claims 17-20 contain allowable subject matter. Applicant thanks the Examiner for allowing claim 17. With respect to claims 18-20, the rewriting of these claims is held in abeyance until arguments presented above with respect to claim 13 have been reconsidered.

VIII. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly invited to contact the undersigned attorney at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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Date: January 25, 2007

Attorney Docket No.: Q68150